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U. S. DEPARTMENT OF
AGRICULTURE

FARMERS' BULLETIN No. 1179

Rev. Apr. 1924

Rev. ed.
follows

FEEDING
COTTONSEED
PRODUCTS
TO LIVESTOCK



COTTON DIVISION COPY

THE FOLLOWING POINTS have been determined from experiments and practical feeding operations. They should be kept in mind and carefully followed in feeding cottonseed products to livestock:

- (1) Do not feed cottonseed meal to young calves.
- (2) Horses and pigs should be fed cottonseed products only in small quantities and then with great precaution.
- (3) Procure prices on high-grade and low-grade cottonseed meal and choose the feed which supplies protein at the least cost.
- (4) For feeding cattle:
 - (a) One pound of cottonseed meal is usually considered worth as much as 2 pounds of corn or its equivalent.
 - (b) Heavy rations of cottonseed meal should be discontinued after 100 to 120 days when dry roughage is fed, and after 150 days when succulent feeds are used.
 - (c) Cottonseed cake may be used profitably as a supplemental feed for fattening cattle on pasture.
- (5) In sections where much corn, stover, fodder, timothy, or other carbohydrate feed is used it is extremely important that some feed like cottonseed meal be used.
- (6) Cottonseed meal stimulates the appetites of fattening animals and causes them to consume more feed and likewise to make greater gains.
- (7) Cottonseed meal is a very valuable protein feed for dairy cows. One pound of good-quality cottonseed meal is usually considered equal to 2 pounds of wheat bran for milk production.

This bulletin supersedes Farmers' Bulletin 655, "Cottonseed Meal for Feeding Beef Cattle."

FEEDING COTTONSEED PRODUCTS TO LIVESTOCK.

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VALUE OF COTTONSEED PRODUCTS AS LIVESTOCK FEEDS.

COTTONSEED PRODUCTS have been used extensively for stock feeding in the South for many years. During more recent times their use has become general in many sections outside the Cotton Belt. The demand from foreign countries is strong, despite the fact that these products cost considerably more there than they do in this country. European feeders, as a rule, have placed more value on high protein feeds than the average American livestock man.

Another reason why cottonseed products are of such great importance, in addition to their high protein content, is their immense production. Although the production of cotton has shown a slight decrease during the last 10 years, the decrease has not been so marked as has been the case with flaxseed, from which linseed meal¹ is made. Several new protein feeds, like peanut cake, copra cake, and fish meal, have been offered on the market during the last few years, but with the average stockman they have not been received with so much favor as cottonseed meal or linseed meal, due in part to their unknown value. These newer products, however, promise to become of more importance in the future, because some of them have distinct advantages over cottonseed products for certain classes of farm animals.

¹This product is also known as "oil meal," and "new-process" and "old-process" meal.

COMPOSITION OF COTTONSEED PRODUCTS.

There are a large number of cottonseed products used as livestock feeds. Both concentrates and roughages are included. All the concentrate products have the same general characteristics and qualities, their chemical composition depending mainly upon the form of manufacture and the thoroughness in separating out the hulls. Among the more common cottonseed products used as feeds are cottonseed, cottonseed meal and cake, and cottonseed hulls. Table 1 gives analyses representing these products, which have been put on the market by manufacturers to conform to the definitions adopted by the Association of Feed Control Officials of the United States.

TABLE 1.—*Composition of cottonseed products.²*

[Pounds of nutrients in 100 pounds.]

Product.	Water.	Ash.	Crude protein.	Carbohydrates.		Fat (ether extract).
				Fiber.	Nitrogen free extract.	
Cottonseed.....	Per cent. 9.1	Per cent. 4.0	Per cent. 19.6	Per cent. 18.9	Per cent. 28.3	Per cent. 20.1
Cottonseed meal:						
Choice.....	7.1	5.7	41.7	10.0	28.4	7.1
Prime.....	6.9	5.9	38.8	12.2	29.4	6.8
Good.....	7.3	5.8	36.8	13.5	30.0	6.6
Cold-pressed cottonseed cake.....	6.9	4.2	27.5	24.2	30.2	7.0
Cottonseed hulls.....	8.7	2.6	3.5	46.2	38.0	1.0

¹ Furnished by the Bureau of Chemistry, United States Department of Agriculture.

GRADES AND CLASSES OF COTTONSEED PRODUCTS.

Formerly cottonseed (uncrushed) was used quite extensively as a feed for livestock. Its value as a source of cottonseed oil and its utilization for commercial purposes has greatly decreased the amount fed in the form of seed. Cottonseed products have taken the place of the seed as a feedstuff. Several feeding tests have indicated that 1 pound of good-quality cottonseed meal is equal to nearly 2 pounds of cottonseed as a feed for fattening steers. Large rations of cottonseed tend to produce scours, but when used in quantities up to 5 or 6 pounds there is little or no trouble from this source.

Cottonseed contains about 21 per cent fat or oil and nearly 22 per cent crude protein. Compared with a good grade of cottonseed meal it contains about half as much protein and about two and one-half times the content of oil.

A ton of cottonseed will yield approximately the following quantities of products:³

	Pounds.
Linters or short fiber.....	110
Hulls.....	514
Cake or meal.....	954
Crude oil.....	303
Loss in manufacture.....	119
 Total.....	 2,000

³ Average for the 5 years 1914-15 to 1918-19 as compiled by the Bureau of Markets, United States Department of Agriculture, from Bureau of Census figures and estimates.

Cottonseed cake is made from the residue which remains after the oil has been extracted from the seed. Ordinarily the greater part of the hulls is removed before the oil is extracted. When this is done the amount of crude fiber in the resulting cake is proportionately smaller. The hulled kernels are crushed, heated, and subjected to great pressure to remove the oil. The residue when of good quality should be a hard, boardlike cake of a yellowish color. The color is often an indication of the quality. The presence of hulls causes the cake to become dark. A dark color may also be caused by overheating during the pressing process or by fermentation, each of which lessens the feeding value.

Cottonseed cake and cottonseed meal are practically one and the same thing; that is, the meal is the cake in a ground form. The meal is most commonly used, but the cake has a distinct advantage in certain cases. European buyers show a preference for the cake for the reasons that there is less loss in handling, it is easier to judge the quality, and because the cake is better adapted for feeding alone or on the ground.

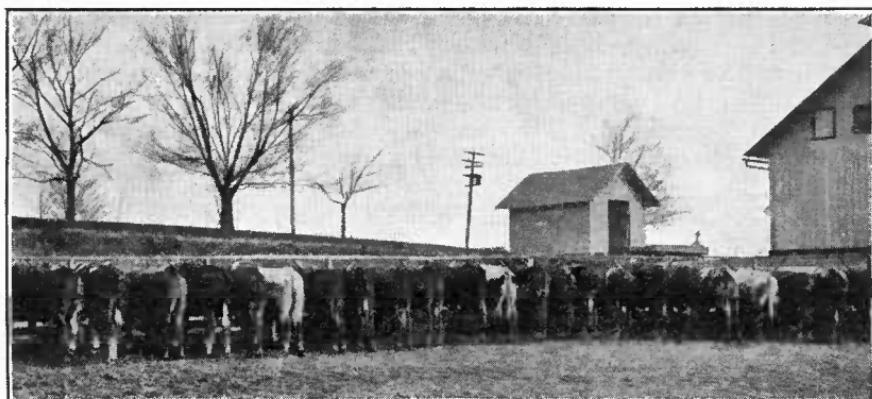


FIG. 1.—Tennessee steers, fattened chiefly upon cottonseed meal and silage. (Courtesy of the Tennessee Experiment Station.)

In the United States the cake is preferred by men who feed their cattle in the open where the wind may blow the meal away. On the range or pasture the cake is often broken up and fed in troughs or spread upon the ground. If meal were used, the loss in feeding in this manner would be very large.

There are many grades and classes of cottonseed products sold on the market. The grades as classified and described by the Association of Feed Control Officials of the United States are as follows:

1. Cottonseed meal.
2. Choice cottonseed meal.
3. Prime cottonseed meal.
4. Good cottonseed meal.
5. Cottonseed feed.
6. Cold-pressed cottonseed (cake).
7. Ground cold-pressed cottonseed.

Cottonseed meal is a product of the cottonseed only, composed principally of the kernel with such portion of the hull as is necessary in the manufacture of oil; provided, that nothing shall be recognized as cottonseed meal that does not conform to the foregoing definition and that does not contain at least 36 per cent of protein.

Choice cottonseed meal must be finely ground, not necessarily bolted, perfectly sound and sweet in odor, yellow, free from excess of lint, and must contain at least 41 per cent of protein.

Prime cottonseed meal must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, yellow, not brown or reddish, free from excess of lint, and must contain at least 38.6 per cent of protein.

Good cottonseed meal must be finely ground; not necessarily bolted, of sweet odor, reasonably bright in color, and must contain at least 36 per cent of protein.

Cottonseed feed is a mixture of cottonseed meal and cottonseed hulls, containing less than 36 per cent of protein.

Cold-pressed cottonseed is the product resulting from subjecting the whole undecorticated cottonseed to the cold-pressure process for the extraction of oil, and includes the entire cottonseed less the oil extracted.

Ground cold-pressed cottonseed is the ground product resulting from subjecting the whole undecorticated cottonseed to the cold-pressure process for the extraction of oil, and includes the entire ground cottonseed less the oil extracted.

Cottonseed hulls are the roughage product of cottonseed-oil manufacture. The hulls are removed from the cotton seed before the oil is extracted. They have a very low-protein content and should be fed only in connection with protein-rich feeds. As a roughage the hulls have a lower feeding value than oat straw or corn stover, but are valuable where no other roughage is available. This product is used extensively in the South, especially for steer feeding.

Cottonseed-hull bran is ground cottonseed hulls from which the lint has been removed. The feeding value of the bran is not appreciably greater than that of ordinary cottonseed hulls.

POISONOUS EFFECTS OF COTTONSEED PRODUCTS.

Cottonseed products, though valuable feeds, are not always safe feeds, especially when fed to certain animals. Experience has shown that their use as a feed for young calves and pigs may result fatally. Just what causes the harmful effects is not known. The products may be used for a limited time with no visibly harmful effects, but their continued use may be fatal. Until more is learned concerning the toxicity of cottonseed meal, it is well to feed it sparingly and with extreme caution to young calves and pigs. It is less harmful to older cattle, but when fed continuously and in large amounts for long periods it may also prove to be harmful even to them. Formerly steers were frequently fed, in the vicinity of cotton-oil mills, as much as from 12 to 15 pounds of cottonseed meal per head per day. As a result of such heavy feeding many became blind, exhibited a staggering gait, and occasionally the legs swelled below the hocks. Some died, while others ceased to gain in weight, went off feed, and then rapidly lost flesh. Even though the feed was changed much trouble was experienced in getting the animals back to a normal appetite and a thrifty condition. Horses and mules may also be seriously affected by the toxic properties of cottonseed meal when it is used in more than limited amounts.

Cottonseed meal, fed in small or moderate amounts, is constipating. For that reason it should be used with more laxative feeds, such as silage, and as a supplement to other concentrates. Its rational use with a variety of feeds will usually overcome the difficulty.

ECONOMY OF USING HIGH-GRADE COTTONSEED PRODUCTS.

Cottonseed products containing a high percentage of protein command relatively high prices, but judged from the cost of the protein contained, they are comparatively cheap. Some feeders prefer to buy the lower-grade products, believing them to be more economical than the better grades. From the standpoint of the cost of the protein in the feeds such men are usually deceiving themselves. These products are usually purchased for their protein content and prices paid should be based on the protein contained in them. To show the value per pound of the protein in feeds at various prices and containing varying guaranteed analyses of protein, Table 2 has been prepared.

TABLE 2.—*Cost of protein per pound in feeds at various prices per ton.*

Cost of feed per ton.	Per cent of protein in feeds.										
	12	16	20	24	28	32	36	38	41	43	45
	Cost per pound of protein.										
\$25.00	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.	Cents.
10.42	10.42	7.82	6.25	5.23	4.47	3.91	3.47	3.29	3.05	2.91	2.77
30.00	12.50	9.38	7.50	6.25	5.36	4.69	4.16	3.95	3.66	3.48	3.38
35.00	14.58	10.94	8.75	7.29	6.25	5.47	4.86	4.61	4.26	4.07	3.89
40.00	16.67	12.50	10.00	8.33	7.14	6.25	5.55	5.26	4.88	4.65	4.44
45.00	18.75	14.06	11.25	9.38	8.03	7.03	6.25	5.92	5.49	5.23	5.00
50.00	20.83	15.63	12.50	10.42	8.93	7.81	6.94	6.58	6.09	5.81	5.55
55.00	22.91	17.19	13.75	11.46	9.82	8.59	7.64	7.24	6.71	6.40	6.11
60.00	25.00	18.75	15.00	12.50	10.71	9.38	8.33	7.89	7.32	6.97	6.67
65.00	27.08	20.31	16.25	13.54	11.67	10.16	9.03	8.55	7.92	7.56	7.22
70.00	29.16	21.87	17.50	14.58	12.50	10.94	9.72	9.21	8.53	8.14	7.78
75.00	31.25	23.44	18.75	15.62	13.39	11.72	10.41	9.87	9.14	8.72	8.33
80.00	33.33	25.00	20.00	16.67	14.28	12.50	11.11	10.53	9.75	9.32	8.99
85.00	35.41	26.56	21.25	17.71	15.18	13.28	11.80	11.18	10.36	9.88	9.44
90.00	37.50	28.12	22.50	18.75	16.07	14.06	12.50	11.84	10.97	10.48	10.00
95.00	39.58	29.69	23.75	19.79	16.43	14.84	13.19	12.50	11.58	11.04	10.55
100.00	41.67	31.25	25.00	20.83	17.86	15.62	13.89	13.16	12.19	11.63	11.11

The poorer grades of cottonseed meal or cake usually sell only a little lower than the prices for the higher-grade products. By obtaining commercial prices on both high-grade and low-grade products and referring to Table 2, one can ascertain approximately which feed will provide protein at the least cost. It must be remembered, however, that the feeding values of different feeds having essentially the same coefficients of digestibility are not exactly proportional to their respective protein contents. A low-protein feed usually has a higher content of carbohydrates, which may partially make up in feeding value for the difference in protein content.

Good cottonseed meal contains three times as much digestible protein and as much digestible carbohydrates and fat combined as there is in wheat bran. One pound of cottonseed meal will balance as much corn as 3 pounds of bran.

Sometimes the analysis of cottonseed meal offered for sale is given on the tag in terms of nitrogen or of ammonia, or it may be quoted

in those terms by feed dealers. One may readily determine the protein content by using the following factors:

Multiply the nitrogen by 6.25. For example, if the analysis is given as 6 per cent nitrogen, then the pounds of protein in 100 pounds of the meal will be 6×6.25 , which is 37.50. This means that it is a good grade of meal.

If the analysis is given in terms of ammonia, multiply the per cent of ammonia by 5.15. For example, if the analysis is given as 7.5 per cent ammonia, the protein in 100 pounds of the meal will be 7.5×5.15 , which is 38.62, meaning that it is a good grade of meal.

COTTONSEED PRODUCTS FOR VARIOUS CLASSES OF LIVESTOCK.

The rations given in the succeeding pages may be used as the average and may be adjusted to suit local conditions. If the suggested rations can not be used, one may substitute other feeds of the same general character as those included in the rations outlined. These rations are primarily designed to show the proper proportions in which to use cottonseed products and no attempt is made to cover all conditions.

In discussions of feeding cottonseed products, the quantities for the different classes of animals are given in pounds. While it is important to weigh the meal as fed, yet it may be entirely satisfactory merely to weigh at frequent intervals the contents of a certain measure or vessel. Table 3, giving weights and measures, may be helpful along this line.

TABLE 3.—*Equivalent weights and measures of cottonseed products.*

Product.	One quart	One pound
	weighs—	measures—
	<i>Pounds.</i>	<i>Quarts.</i>
Cotton seed.....	0.8	1.3
Cottonseed meal.....	1.5	.7
Cottonseed hulls.....	.3	3.3

FATTENING CATTLE.

It is for fattening cattle that cottonseed concentrates serve their greatest usefulness. A very large percentage of cottonseed feeds is used for cattle fattened for market. The usual feeding period for this class of cattle is from 90 to 120 days, and during that period comparatively large quantities of cottonseed cake or meal are used. When steers are not fed more than 7 pounds of cottonseed meal a day, they can usually be fed from 100 to 120 days without showing any signs of cottonseed-meal poisoning. If silage or other succulent feed is given as roughage, the meal can be fed longer without harmful results.

When cattle are fed a ration composed only of cottonseed hulls and meal, they usually make good daily gains for the first 60 days, after which the gains diminish rapidly, and after 90 to 100 days they are seldom satisfactory. For a short feeding period cottonseed hulls and meal give satisfactory results. If the roughage is silage instead of hulls, the daily gains are more nearly uniform through-

out the feeding period, and if care is used in feeding the meal it can be fed for 150 days without ill effects.

In many of the leading cattle-feeding sections of the Corn Belt cottonseed meal is used extensively, especially as a supplement to silage. Where alfalfa is grown successfully, as in the western part of the Corn Belt, little or no cottonseed meal is used. Not only has it proved to be economical for fattening cattle in the winter, but many feeders use the cake as a supplement to grass. Its use in most feeding sections is limited to 3 or 4 pounds a day for cattle averaging 1,000 pounds live weight.

One reason why cottonseed meal is highly prized for feeding cattle is that it puts on a glossy finish, which makes them sell better than cattle having harsh, rough coats. There is also a tendency for cattle receiving cottonseed meal to put on a smooth, even covering of firm flesh.



FIG. 2.—These fat yearling steers, fed in West Virginia, received a ration of silage and cottonseed meal.

Suggested rations for fattening steers averaging 1,000 pounds in weight.

RATION 1.		RATION 3.	
	Pounds.		Pounds.
Corn (or sorghum) silage	25	Sorghum (or kafir) silage	35
Mixed hay	10	Grass hay or stover	6
Corn	10	Cottonseed meal or cake	4
Cottonseed meal	3	Kafir (or milo) chops	10

RATION 2.		RATION 4.	
	Pounds.		Pounds.
Wet beet pulp	80	Sorghum silage	30
Prairie hay	10	Grass hay or stover	6
Beet molasses	4	Velvet beans in pod	6
Cottonseed meal	4	Cottonseed meal	3

STOCK CATTLE.

For stock cattle the use of cottonseed meal is ordinarily confined to the winter period, and then only in amounts sufficient to add to the ration the protein required. It is especially valuable to use in connection with cheap roughages and silages which are highly carbonaceous feeds. For stock cattle weighing 500 to 750 pounds, from 1 to 2 pounds of the meal is enough to balance properly most roughage rations. When legume hays are used the cottonseed meal

may be materially reduced and sometimes entirely eliminated to advantage. If alfalfa or clover constitutes half or more of the roughage ration, there is little or no need for the use of additional protein-rich feeds.

Few combinations are more economical than a ration of corn silage and cottonseed meal for wintering stock cattle. One to two pounds of cottonseed meal combined with whatever silage stock steers will eat will keep them in good, thrifty condition and cause them to make a profitable gain. The cost of wintering such cattle can usually be lessened by permitting the steers to run in the stalk fields and giving them feed at night only. Straw and other roughages which can not be used to advantage in any other way may be fed with silage and cottonseed meal.

Suggested rations for wintering stockers averaging 750 pounds in weight.

RATION 1.		RATION 3.	
	Pounds.		Pounds.
Corn (or sorghum) silage	25	Corn-stover silage	25
Oats or wheat straw	Unlimited.	Grass hay	6
Cottonseed meal	½ to 1½	Cottonseed meal	½ to 1½

RATION 2.		RATION 4.	
	Pounds.		Pounds.
Corn (or sorghum) silage	25	Cottonseed cake	1 to 1½
Oats or corn	2	Silage, to supplement winter pastures	15 to 20
Cottonseed meal	½		
Straw or stover	Unlimited.		

BREEDING CATTLE.

In feeding cottonseed meal to beef cows, two classifications may be made—dry cows and cows that nurse calves. The dry cows may be handled in much the same manner as stock cattle. The amount of cottonseed meal that should be fed to this class of cows depends on the other feeds used. Some feeders use excessive quantities of cottonseed meal, causing the cost of the ration to become uneconomically high. From 1 to 1½ pounds of cottonseed meal may be fed daily with other feeds, such as corn silage and good hay. Where corn silage is available, a good ration for breeding cows would be 25 to 30 pounds silage, from 1 to 1½ pounds cottonseed meal or cake, and other roughage, such as stalk fields, corn stover, hay, or straw.

Cows that are nursing calves should receive more protein supplements than dry cows, but the amounts fed should not be greater than is necessary to balance properly the other feeds, which may consist largely of roughages. Ordinarily beef cows raising calves are fed not more than 2 pounds each daily, and then only during the winter period.

Suggested rations for wintering beef-breeding cows averaging 1,000 pounds in weight.

RATION 1.		RATION 3.	
	Pounds.		Pounds.
Corn silage	25 to 30	Grass hay or stover	18 to 20
Cereal straw or stover	Unlimited.	Cottonseed meal or cake	1½ to 2
Cottonseed meal	1 to 1½		

RATION 2.		RATION 4.	
	Pounds.		Pounds.
Corn (or sorghum) silage	25 to 30	Kafir (or milo) silage	30 to 35
Cottonseed meal	1 to 1½	Kafir or milo stover or cereal straw	Unlimited.
Winter pasture		Cottonseed meal or cake	1½

CALVES.⁴

It is well not to use cottonseed meal at all until the calf is 3 to 4 months old, and then only in a limited way. By the time the calf is 1 year old it may be eating from $\frac{1}{2}$ to $1\frac{1}{2}$ pounds a day with comparative safety. For young calves, linseed meal is by far a better feed and is to be preferred. Contrasted with cottonseed meal, linseed meal contains no toxic substances, and the high content of mineral matter makes it especially valuable for young stock of all kinds. Cows suckling calves may be fed cottonseed meal in moderate amounts without any detrimental effect to the calves.

DAIRY COWS.

Dairy cows are often fed comparatively large quantities of cottonseed products, sometimes for long periods of time. The amount of cottonseed meal to use should be regulated partly by the production of butterfat and the nature of the other feeds used. One must remember also that cottonseed meal or cake is constipating and should be used with more laxative feeds, such as linseed meal, wheat bran, silage, or roots. When used in large quantities for dairy cows it produces hard, tallowy butter, light in color and poor in flavor. When used in moderate amounts the quality of the products need not be impaired and in many instances can be improved if the other feeds tend to produce soft butter. The cottonseed products are heavy, concentrated protein feeds and for best results should be used with lighter and more bulky feeds. For average dairy cows the use of cottonseed products should be limited to 2 or 3 pounds a day when used in connection with other concentrates.

Suggested rations for a 1,000-pound dairy cow, giving 25 pounds of 4 per cent milk daily.⁵

RATION 1.		RATION 3.	
	Pounds.		Pounds.
Clover hay	10	Barley (or oat) hay	15
Corn (or sorghum) silage	35	Clover or alfalfa hay	5
Ground corn	3	Dried beet pulp (soaked)	5
Wheat bran	2	Cottonseed meal	2
Cottonseed meal	2		

RATION 2.		RATION 4.	
	Pounds.		Pounds.
Roots (mangels)	20	Corn (or sorghum) silage	35
Mixed hay	15	Grass hay	10
Corn-and-cob meal	2	Corn chops	4
Crushed barley	3	Cottonseed meal	2 $\frac{1}{2}$
Cottonseed meal	2 $\frac{1}{2}$		

BULLS AND YOUNG STOCK.

It is not advisable to feed bulls more than a very limited ration of cottonseed meal; many practical stockmen say that it impairs the breeding qualities of the animal. Bulls should receive a sufficiency

⁴ Those interested in beef production should send for Farmers' Bulletin 1135, "The Beef Calf; its Growth and Development," and Farmers' Bulletin 1073, "Growing Beef on the Farm."

⁵ Those desiring detailed information on this subject should send for Farmers' Bulletin 743, "The Feeding of Dairy Cows."

of protein-rich feeds, but cottonseed meal should be used only in moderate amounts. Throughout the winter it may be used for the bull to the extent of $1\frac{1}{2}$ or 2 pounds along with other concentrates, such as bran, corn, and oats.

It is highly important that young stock of both beef and dairy breeds intended for breeding purposes be supplied with an abundance of protein and mineral matter. Although cottonseed products are not so valuable as linseed meal for this purpose, they are especially valuable as a source of protein. As previously stated, their use should be very limited before the calves are 4 months old, but may be increased to $1\frac{1}{2}$ pounds by the time the animal is a year old.

HOGS.

As stated, hogs are especially susceptible to poisoning from cottonseed meal. Cottonseed products to the extent of one-fourth of the concentrate ration have been used for short periods of 40 days or less, frequently without harmful effects. But usually if the cottonseed meal is fed for more than 5 or 6 weeks, harmful results will follow. By decreasing the amount of meal, or by supplying pasture or other succulent feeds, the poisoning may be delayed. As yet no satisfactory way of neutralizing the poison has been found. It would be well for the experienced as well as the inexperienced swine feeder to let cottonseed meal alone and use such safe protein feeds as tankage, fish meal, linseed meal, and skim milk.

Before the use of cottonseed meal became general, cattle feeders believed that hogs following the steers in the feed lot might become poisoned. Experience has shown, however, that no detrimental results follow this practice. Evidently the toxic substances have become neutralized in the process of digestion. When the meal or cake fed to the cattle is not accessible to the pigs, there is no danger that the pigs will be poisoned by eating the waste feed in the droppings.

HORSES.

Cottonseed meal has met with considerable disfavor among horse feeders because they say it causes digestive disorders. There may be considerable truth in this statement, because many horses have been killed by the feeding of excessive quantities of cottonseed meal. In too many cases, however, the quality of cottonseed meal has not always been the best or the quantity safeguarded. Horses are very susceptible to injury from eating moldy feed and this applies particularly to the use of cottonseed products. In the South, plantation owners often feed their mules on cottonseed meal in conjunction with corn, with apparently good results. Quite often it is used in connection with blackstrap molasses and grain.

The use of cottonseed meal for horses and mules can be recommended only in limited quantities, and then care must be exercised in securing cottonseed meal of good quality. Horses should be started on the meal gradually and it should always be used as a supplement to a carbonaceous feed, such as corn. The meal is not relished by horses and, being unpalatable, it should be well incorporated with other feeds. While it has been fed in larger quan-

ties in a few cases, the best results may be obtained by limiting the amount to 1 pound per 1,000 pounds live weight, and by giving special attention to the horses receiving the cottonseed meal.

Suggested rations for a 1,000-pound horse at medium work.

RATION 1.		RATION 3.	
	Pounds.		Pounds.
Oats	12	Rolled barley	10
Timothy hay	10	Oat hay	10
Cottonseed meal	4	Cottonseed meal	4

RATION 2.		RATION 4.	
	Pounds.		Pounds.
Shelled corn	10	Shelled corn	6
Molasses	2	Wheat bran	4
Grass hay	8	Cottonseed meal	1
Cottonseed meal	1	Timothy hay	10

SHEEP.

In feeding sheep it is highly important to balance properly the rations used. Protein-rich concentrates can be used advantageously for this purpose. Cottonseed meal and cake have been used for fattening sheep with fairly satisfactory results, but not so extensively as linseed meal. In limited quantities it may be used to advantage.

Cottonseed meal and cake are also used to advantage in limited quantities for breeding ewes. One-half pound a day meets their requirements.

Sheep should be started on cottonseed products in small quantities. Lambs when on full feed should receive not more than one-third of a pound a day when fed no other concentrates, and only one-eighth to one-fourth of a pound in combination with other grains. It is advisable to use cottonseed meal in connection with corn, oats, or similar grain. Sheep usually relish cottonseed cake more than the finely ground meal.

Suggested rations for 60-pound fattening lambs.

RATION 1.		RATION 3.	
	Pounds.		Pounds.
Shelled corn	1.0	Corn silage	1.2
Grass hay	1.0	Barley	1.0
Cottonseed meal	.3	Cottonseed meal	.2
		Clover hay	.6

RATION 2.		RATION 4.	
	Pounds.		Pounds.
Shelled corn	1.2	Barley	.6
Alfalfa	.4	Wet beet pulp	3.0
Corn silage	.6	Cottonseed meal	.3
Cottonseed meal	.2	Prairie hay	1.0

COTTONSEED MEAL OR CAKE FOR PASTURE FEEDING.

For years feeders, of the Southwest particularly, have used 1 to 2 pounds of cottonseed cake for feeding cows and steers on range in the fall and winter. Somewhat more cottonseed cake or some roughage as suggested on pages 10 and 11 should be fed when the grass is covered with snow and also during periods of grass shortage. The fattening of cattle on grass with cottonseed cake during the spring and summer months has during more recent years been found to be an economical practice. The cake is usually

preferred to the meal for grass feeding. In regard to feeding cake in preference to meal, a former publication of the bureau is here quoted:⁶

There are several advantages in feeding cake in place of meal, especially in summer feeding. A rain does not render the cake unpalatable, but it will often put the meal in such a condition that the cattle will not eat it. Again, no loss is incurred with the cake during windy days, whereas the meal, when fed in the open pasture, is sometimes wasted on account of the high winds. Furthermore, the cake requires chewing before being swallowed and therefore must be eaten very much slower than the meal, so when a number of steers are being fed together the greedy one has little chance to get enough cake to produce scours. When cottonseed meal is fed, the greedy steer often scours, because he can bolt the meal and get more than his share; this not only injures the steer but makes the bunch "feed out" unevenly.

In experiments conducted in the Southeast by the Bureau of Animal Industry in which the cake was fed in troughs in the pasture, it was found after several years' work that the feeding of cottonseed cake to cattle on pasture caused the cattle to fatten more rapidly, to develop greater finish, and to make greater profits in most cases than with similar cattle which received pasture alone. The value of the cake as a supplement to pasture, of course, depends to a considerable



FIG. 3.—Inspecting cattle and hearing reports of experimental work at Canton, Miss. The steers were fattened largely on silage and cottonseed meal.

extent upon the nature of the pasture grasses, its use for legumes not being so profitable as with true grasses. As a rule, however, the feeding of cottonseed cake on good grass pasture is not highly profitable. The stage of maturity of the grass is also of significance in this connection, because dry, mature grass is of a more carbonaceous nature than grass in earlier stages of growth.

EXPERIMENTAL RESULTS SHOWING THE VALUE OF COTTONSEED PRODUCTS IN RATIONS.

VALUE OF PROTEIN SUPPLEMENT FOR STEER FEEDING.

Numerous experiments have conclusively shown the value of protein supplements when added to rations deficient in protein. The following summary covers four experiments, averaging 132 days, with 2-year-old steers, in which a nitrogenous supplement was added to a ration of corn and a carbonaceous roughage.

The addition of the protein supplement increased the average daily gain 0.6 pound a day and reduced the total concentrates

⁶ From Bureau of Animal Industry Bulletin 131, "Beef Production in Alabama."

required to produce 100 pounds gain from 1,082 pounds to 862 pounds and the roughage from 522 pounds to 402 pounds.

TABLE 4.—*Summary of four feeding experiments showing the value of a protein supplement.*¹

Ration.	Number of steers.	Average daily gain.	Feed per 100 pounds gain.		
			Concentrates.		Carbo-naceous roughage.
			Corn.	Protein supplement.	
Corn and carbonaceous roughage	44	Pounds.	Pounds.	Pounds.	Pounds.
Corn, protein supplement, and carbonaceous roughage	54	1.60	1,082	96	522
		2.20	766		402

¹ Bulletin references: Illinois Experiment Station Bulletin 83; Indiana Experiment Station Bulletin 115; Nebraska Experiment Station Bulletins 90 and 93.

COTTONSEED MEAL COMPARED WITH OTHER CONCENTRATES FOR DAIRY COWS.

At the New Jersey station four cows were fed for 66 days on a ration of corn silage and corn stover, with either cottonseed meal alone or a mixture of equal parts of wheat bran and dried brewers' grains for the concentrate allowance, the latter being fed alternately, with the result shown in Table 5.

TABLE 5.—*Summary of feeding experiment showing relative value of cottonseed meal and other concentrates.*¹

Ration 1:	Feed.	Average daily yield.	
		Milk.	Butterfat.
Corn silage	Pounds.	Pounds.	Pounds.
Corn stover	.6		
Cottonseed meal	4.5		
		22.7	0.96
Ration 2:			
Corn silage	36		
Corn stover	.6		
Wheat bran	.5		
Dried brewers' grains	.5		
		23.9	.95

¹ From New Jersey Experiment Station Report for 1903.

In this experiment 4.5 pounds of cottonseed meal were found to be practically equal to 5 pounds of wheat bran and 5 pounds of dried brewers' grains. Most dairymen conclude that 1 pound of good-quality cottonseed meal is equal to 2 pounds of wheat bran for milk production.

PASTURE SUPPLEMENTED WITH COTTONSEED CAKE.

TABLE 6.—*Value of cottonseed products as a supplement to pasture in steer feeding.*¹

Lot.	Ration.	Average daily gain.	Daily ration of concentrates.	Selling price of cattle.	Profit per steer.
Lot A	Pasture alone	Pounds.	Pounds.	\$3.66	\$2.86
Lot B	Pasture plus cottonseed cake	1.52 2.32	3.31	4.53	10.42

¹ From Bureau of Animal Industry Bulletin 131.

The addition of 3.31 pounds of cottonseed cake a day as a supplement to the grass increased the daily gain 0.80 pound or from 1.52 to 2.32. The use of the protein supplement increased the selling prices of the cake-fed cattle, so that they made a greater profit than the cattle receiving grass alone. (See Table 6.)

COTTONSEED MEAL AS A SUPPLEMENT TO CORN AND A CARBONACEOUS ROUGHAGE FOR FATTENING LAMBS.

In Table 7 the results of four experiments, averaging 80 days, show the effect of adding cottonseed or linseed meal to a ration of timothy hay and corn.

TABLE 7.—*Effect of cottonseed meal or linseed meal as a supplement to timothy hay and corn for lambs.*¹

Ration.	Daily gain.	Feed for 100 pounds gain.	
		Concentrates.	Hay.
Corn	Pounds.	Pounds.	Pounds.
Timothy hay	1.2	0.23	520
Corn	1.0		448
Timothy hay	1.2		
Cottonseed (or linseed) meal	1.0	.30	463
	.2		334

¹ From Ohio Experiment Station Bulletin 245, Minnesota Experiment Station Bulletin 31, and Indiana Experiment Station Bulletin 162.

The use of a small quantity of protein-rich concentrate increased the daily gains 30 per cent and made a saving of 57 pounds of concentrates and 114 pounds of roughage per 100 pounds gain.

LINSEED MEAL AND COTTONSEED MEAL FOR FATTENING SHEEP.

TABLE 8.—*Summaries of sheep-fattening experiments showing comparative value of linseed meal and cottonseed meal.*¹

Ration.	Initial weight.	Daily gain.	Feed for 100 pounds gain.	
			Concentrates.	Hay.
Ohio station, 112-day trial:				
Lot 1. 40 lambs—				
Linseed meal	Pounds.	Pounds.	Pounds.	Pounds.
Shelled corn	0.2	1.0	65	0.30
Clover or alfalfa hay		1.5		
Lot 2. 40 lambs—				
Cottonseed meal	0.2	1.0	67	.31
Shelled corn				
Clover or alfalfa hay	1.5			
Missouri station, 98-day trial:				
Lot 1. 20 yearling wethers—				
Linseed meal	0.2	1.1	79	.25
Shelled corn				
Clover hay	1.1	1.8		
Lot 2. 20 yearling wethers—				
Cottonseed meal	0.2	1.1	78	.24
Shelled corn				
Clover hay	1.1	1.8		

¹ From Ohio Experiment Station Bulletin 179 and Missouri Experiment Station Bulletin 115.

In the trials listed in Table 8 cottonseed meal and linseed meal showed substantially the same value for balancing the rations of fattening lambs and wethers. Whether to use cottonseed or linseed meal as a protein supplement for fattening sheep depends to a very large extent upon their relative prices and availability.